

2003 Roadmap and SSES White Paper

Jonathan I. Lunine

Objectives

1. Learn how the Sun's family of planets and minor bodies originated.
2. Determine how the solar system evolved to its current diverse state.
3. Determine the characteristics of the solar system that led to the origin of life
4. Understand how life begins and evolves
5. Explore the space environment to discover hazards to Earth
6. Understand the current state and evolution of the atmosphere, surface and interior of Mars
7. Determine if life exists or has ever existed on Mars
8. Develop an understanding of Mars in support of possible future human exploration

Structure of the Roadmap

Science Objectives and flowdown

- Objective
 - Research focus areas
 - Investigations
 - Missions

Example:

- Understand how life begins and evolves
 - Identify the sources of simple chemicals important to prebiotic evolution and the emergence of life (8)
 - Determine the chemical composition of comets and KBO's (18)
 - Study Titan atmospheric chemistry and surface/atmosphere interactions (19)
 - *Titan surface studies and atmospheric probe*
 - *Titan in-situ exploration*
 - Study Earth's geologic and biologic records to determine the historical relationship between Earth and its biosphere (9)
 - Investigate the development of biological processes on the early Earth through molecular, stratigraphic, geochemical and paleontological studies (20)
 - Examine the record of the response of Earth's biosphere to extraterrestrial events (21)
 - *Earth-based lab and field studies*

Mission roadmap

- Solar System Exploration
 - Discovery: Launch rate every 2-3 years
 - New Frontiers: NH (2006), then subset of Lunar SP-AB, Jupiter Int. Struc/Deep Comp., Venus Surface-Atmosphere Comp/dyn., Comet surf. sample anal.
 - Flagship: JIMO, then Titan explorer and/or Neptune orbiter/probes and/or Venus sample return
- Mars (order depends on pathways/discoveries)
 - Mars Scout (every other Mars opp. beg. 2007)
 - Mars Science Laboratory (2009-on)
 - Mars Telesat (2009)
 - Mars Network
 - Mars Sample return
 - Post 2016 Mars missions (long-range rovers, deep drilling, polar, sample return....)

Technology

- Broad benefit
 - In-space propulsion
 - Nuclear systems
 - Communications
 - Avionics
 - Software
 - Data validation, archiving, and analysis
- In-situ exploration and sample return
 - Entry, descent and landing
 - Autonomous planetary mobility
 - Severe environments
 - Sample return technologies
 - Planetary protection technologies
- Science instruments
 - Remote sensing
 - In-situ exploration

Research and Analysis

- R&A programs—growth to keep up with flight mission rate; timeliness of grant funding
- Data analysis programs—an integral part of future mission planets
- Planetary data system—upgrade with new technologies and methodologies
- Lab and computational facilities—continual improvements
- Sample return facilities—maintain and upgrade significantly
- DSN—upgrade receivers, array antennas, evolve opcom
- NEO and KBO surveys—use when required to support missions

Education and Public Outreach

- Principles
 - Work thematically
 - Infuse and use planetary science data and technology
 - Involve scientists, engineers and NASA staff
 - Reach diverse audiences
 - Work closely with partners
- Formal (school), informal (communities), public outreach

SSES Roadmap “white paper” 2005

- GOAL #1: LEARN HOW THE SUN’S FAMILY OF PLANETS AND MINOR BODIES ORIGINATED
 - OBJECTIVE #1: Understand conditions in the solar accretion disk and processes marking the initial stages of planet formation
 - ***Investigation 1a: Chemical and isotopic compositions of primitive meteorites and their components..***
- GOAL #2: UNDERSTAND THE ORIGIN AND UBIQUITY OF LIFE
- GOAL #3: DETERMINE HOW THE SOLAR SYSTEM EVOLVED TO ITS CURRENT DIVERSE STATE
- GOAL#4: EXPLORE THE SPACE ENVIRONMENT TO DISCOVER HAZARDS AND RESOURCES FOR LIFE.

etc. etc. Then a list of missions follows each goal

The SSES white paper is mature in terms of the scientific state-of-knowledge and is concordant with the NAS decadal survey. Please read it for a solid science background to the current roadmap preparation